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Geoenvironment and Related Disasters – A Geospatial Approach

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Abstract

Natural disasters have become fast growing epidemics around the world in general, the disasters like earthquakes, landslides, floods, cyclones and other coastal hazards etc., are already crippling the development and growth of the country. In the recent decades, the "Earth Observing Satellites" which are producing unparallel pictures on various spectral, spatial and temporal resolutions, where as the fast emerging "Geospatial Technology" (GIS) has proved its credentials beyond doubt in storing, manipulating, modeling and visualizing various phenomena related to Earth System Dynamics. In this context, the present paper discusses to map the disasters like earthquakes, landslides, soil erosion, floods and cyclone on their pattern and spatial variation. The Geomatics based integrated terrain analysis, leading to the detection of landslide prone areas, causative factors, predictive models leading to the early warning system etc., Flood is yet another major disaster causing greater impediment to country, which are aspiring to grow faster. Though methodologies have been developed for flood hazard zonation mapping, the geomatics has not been utilized to its deserving levels. And concluded that the geospatial data bases which provide important inputs for studies in the emerging areas of environmental monitoring, global warming and climate change.

Keywords: *Antibacterial Activit; Agar Well Diffusion Method; Salpn.*

1. INTRODUCTION

Natural disasters are inevitable, and it is almost impossible to fully recoup the damage caused by the disasters. But it is possible to minimize the potential risk by developing early warning strategies, preparing and implementing developmental plans to provide resilience to such disasters, and helping in rehabilitation and post disaster reduction. Natural hazard like earthquakes, landslides, floods, cyclones, drought, forest fires and volcanic eruptions have been caused by the vagaries of nature, often aggravated by human intervention, has wide spread devastation at one time or other parts of the world. The geoinformatics of natural disaster management can be successful only when detailed knowledge is obtained about the expected frequency, character and magnitude of hazard events in an area. Recent past huge economic losses attributable to such calamities in developing countries may represent as much as 10 % of gross national product. Among various natural hazards, landslides, earthquakes, and cyclone: floods, forest fire etc are the natural hazards that cause extensive damage in the country every year. Space technology can play a significant role in natural hazard prediction, assessment, monitoring and mitigation. India , with its varied geographical, geological and climatic conditions, is affected by major hazards / disasters – cyclones in the east and west coastal areas, floods in the river valleys Ganga – Yamuna, Brahmaputhura, Godavary, Krishna etc. Earthquakes in the Himalayas, drought in the major arid and semi arid tracts of Central / Southern India. Considerable understanding has been gained in recent times on the evolution and characteristics features of natural hazards. Although, natural disasters have shown in the last decades a drastic increase in magnitude and frequency, it can be observed that there is a dramatic increase in technical capabilities to mitigate them.

The space technology provides data base from which the evidence left behind by disaster that have occurred before can be interpreted, and be combined with the other information to arrive at hazards maps, indicating which area is potentially dangerous. Using remotely sensed data such as imageries and aerial photos allows us to map the variability of terrain properties like vegetation, water, geology both in space and time. Communication satellite provides disaster

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warning and relief mobilization, Earth observation satellite provides required database for both pre and post disaster preparedness programmes. They provide comprehensive, synoptic and multi temporal coverage of large areas in real time and at frequent intervals. Understanding of proactive measures in GIS has created opportunities for a more detailed and rapid analysis of natural hazards. GIS database can be used to create elaborate and effective Disaster Management Information. GIS based Decision Support System (DSS) provides an advanced modeling system for environmentalists so that they can reliably generate and simulate more information about environmental parameters. One of the key components in spatial DSS is the Data Warehousing and analysis. GIS operates as a front – end with disaster management database, providing it with the flexibility to respond to user queries regarding specific details. GIS allows the combination of different kinds of spatial data with non-spatial data and attribute data that can be used at various stages of disaster management.

2. NATIONAL AND GLOBAL SCENARIO

Remote sensing is an important tool for understanding the dynamics of earth surface processes. The applicability of remote sensing in monitoring the environmental impacts of human activity is immense. Remote sensing technology is an important tool in delineating high temperature earth features such as coal mine fire, surface fire, volcano etc. Several environmental hazards like coal-fire, subsidence due to mining activity are being monitored from satellite data. Satellite based thermal data from medium resolution thermal channel like ASTER can help in periodic monitoring of coal fires in coalfields on India, China, Africa. Microwave data (ERS data, Radarsat-2) with tandem acquisition can help in determining the subsidence associated with the mining activity. Moreover, in microwave data (ERS data, Envisat ASAR, Radarsat-1&2) are of great use in monitoring natural and artificial oil-slick mapping. The major application of thermal remote sensing was confined to delineating coal fires and estimating the spatial extent and temperatures of coal fires. During 1960s, when air borne thermal sensor data and later when satellite borne thermal scanner data became available, remote sensing-based coal fire detection and monitoring became operational (Gangopadhyay *et al.* 2005). At the later stage of research, pixel integrated NDVI value obtained from medium to high resolution space borne sensors like TM/ETM, IRS/LISS, etc. have been found appropriate to derive average emissivity of land surface classes. It is found that NDVI has empirical relationship between average value of thermal emissivity and normalized difference vegetation index (NDVI) for different surface covers (Van de Griend and Owe, 1993). This empirical relationship has been proved from the field measurement of the both the parameter.

2.1 Earthquake and Environment

Earthquakes are known to cause extensive damage and are among the most unpredictable of natural disasters. It is estimated that about 50 % of Indian sub continents is subjected to varying degree of earthquake hazard, which is simply demonstrated by the fact that more than 750 eathquake in excess of magnitude of 5 have been recorded in this domain during the last century. Majorities of these are located in the Himalayas, seismically one of the most active intercontinental region in the World. Remote sensing data has been found quite useful in assessing the surface changes subsequent to the earthquake, damage assessment and morph structural zoning. It also mapping of active faults using neo tectonic studies with the use of LANDSAT TM / SPOT, IRS or Radar and in the measurement of fault displacements using SLR, GPS. In seismic microzonztion the use of satellite remote sensing is very limited as the data is derived from accelerometer, geo- technical mapping, groundwater modeling and topographic modeling at large scales.

Earthquake risk assessment involves identification of seismic zones through collection of geological / structural, geophysical and geomorpological data and mapping of known seismic phenomena in the region.

In the phase of disaster relief, pre and post remotely sensed data PAN merged and IKONOS data useful assessing the surface changes subsequent to the earthquake and damage assessment like landslides, major fissures and cracks and land use/ land cover changes, structural damage to buildings also observed. Earth quake, a comprehensive GIS integrated remote sensing visualization models on the earthquake scenario, and there form the demarcation of seismic corridors, micro seismic zonation of vulnerable cities etc., For landslides, GIS based models so for done have led to the invention of new genetic slope mapping and slope stability analysis etc.

2.2 Landslides and Environment

The landslide has become a fast spreading epidemic in mountainous systems of several parts of the world (Davison, 1889; Wentworth, 1943; Varne, 1958;

Bartarya and Valdiya, 1989; Kelarestaghi, 2003). This phenomenon is being witnessed more in mountainous systems of faster urbanization, tourism and industrial developments. Hence, the scientists, technocrats and the planners have concluded that the anthropogenic activities in general are the prime contributor to landslides. (Ramasamy and Muthukumar, 2008) have indicated that various earth system processes and the related landsystems Viz: Lithology, structure and tectonics including neotectonic, Geomorphology, Land use / land cover dynamics, Hydrological dynamics etc., assign different grads of Landslide vulnerability to the terrain systems and Rainfall and other anthropogenic activities act only as the triggering parameters for landslides. The Geostationary operational environmental satellites in combinations with land measurement sensor such as AVHRR (Advanced High Resolution Radiometer) have proved for delineation of disaster events aftermath. The Synthetic Aperture Radar (SAR) Interferometery has provided the opportunity for preparing Digital Elevation Model for landslide prone areas. The LIDAR holds a tremendous promise as it can provide vey high resolution terrain information and terrestrial photogrammetric survey: a technique of preparing large scale maps during landslide hazard zonation mapping in the hilly areas. Also normal satellite data and infra red imagery and Orthophots are being used for landslide studies. There are numerous approaches for hazard zonation mapping. The study area landslide types are mapped by large scale spatial data, pale scars and field survey, classified and landslide distribution map in GIS environment. From the distribution data, all the landslide morphology can be measured through spatial data and ground measurement. Then generate the thematic layers for landslides controlling parameters. The following are the contributing parameters to be generated - Subsurface geology, lineaments, geomorphology, slope, soil types, drainage, groundwater, rainfall, area of toe removal and land use/land cover etc. After the preparation of this data base, weightages for individual variables related to their vulnerability index are assigned. After assigning the weightages, all the thematic data bases were classified in to vulnerable and non vulnerable for individual parameters. Say example geo-morphogically controlled landslide vulnerable data were generated. After that, parameters using GIS overlay function were integrated. The final integration will give number of polygons by means of piece of land with multivariate parameters loaded. Based on those parameters, the entire area will be regrouped and can be classified into, most vulnerable zone, moderately and least vulnerable zones. The GIS will provide each parcel of land with what type of parameter is loaded. Based on the parameter loaded the remedial measures can be suggested. Usually, remedial measures are adopted based on the influencing parameters loaded in the polygon. The remedial measures include - Surface drains, placement of netting, construction of peripheral walls, creation of fractured filled vegetation, afforestation, and parallel piping with perforated pipes and inter connecting catch water drains, nailing and concrete grouting, terracing, drainage channelling and stabilizing the bottom of the slopes.

2.3 Soil Erosion and Environment

Soil erosion is a natural geological phenomenon occurring due to removal of soil particles by water, wind and human activities, transporting them elsewhere depending upon rainfall, topography, vegetation, soil and land use practices. Soil erosion begins with detachment, which is caused by break down of aggregates by raindrop impact, sheering or drag force of water and wind. Detached particles are transported by flowing water (over-land flow and inter-flow) and wind, and deposited when the velocity of water or wind decreases by the effect of slope or ground cover. The use of remote sensing and geographical information system (GIS) techniques makes soil erosion estimation and its spatial distribution feasible with reasonable costs and better accuracy in larger areas (Millward and Mersey, 1999; Wang et al., 2003). Nuket Benzer (2009) to establish a geographical information system method for spatial assessment of soil erosion based on the universal soil loss equation (USLE), and to evaluate the utility of GIS with regard to soil erosion mapping. Babita Pal and Sailesh Samanta (2011) describe the application of RS and GIS techniques lend to estimate soil loss based on different parameters. Tagore et al., (2012) has carried out to map the areas with erosion using remotely sensed data (Kharif, Rabi and Summer Season) from Indian Remote Sensing (RS) satellite (IRS P-6) LISS III sensor. For assessing the soil erosion prone area of the study area, various thematic layers are considered. Each theme has different importance in the context of determining the soil erosion zones. The terrain parameters of each layer having different ranks zones of GIS, images were integrated using overlay function of Arc GIS by assigning suitable weightage factors. The weightages are assigned to each category of the thematic layer. Hence each thematic layer is assigned a rank based on their influence on the Soil erosion. The different classes in each theme are assigned a knowledge Based weightages. Here the lower weightage indicates poor factor in causing the soil erosion. The prevention of soil erosion, which means reducing the rate of soil loss to approximately that which would occur under natural conditions, relies on

selecting appropriate strategies for soil conservation and this, in turn, requires a thorough understanding of the processes of erosion. The study area, each thematic layer was superposed with the soil erosion data one by one and identify their causative factors were detected through GIS by high ranks of the individual parameters were mapped those areas are classified as vulnerable zone and remaining areas are unvulnerable zone for soil erosion for concerned parameter. The study area causative parameters of soil erosion are discussed below individually. Based on the induced/ influenced parameters the remedial measures was suggested individual parameter or combinations of parameters. Such as rainfall, slope, drainage density, lineament, geomorphology, soil types and land use pattern controlled areas were identified accordingly common remedial measures are sowing and planting, check bunds, check dams, gully plugs, and water harvesting structures. In addition the land use controlled soil erosion prone areas Conservation of cultivable land cause can be achieved not only through preventive and remedial measures in order to control land erosion and degradation. The suggestions are by using the alternative innovative agricultural technologies which involve use of organic farming or green manures, bio fertilizers and biological pest control. The development activities in the built up areas the authorities should monitor and strictly adhere the rules and regulation of construction of houses and buildings in the town areas and also other economic activities.

2.4 Flood and Environment

Flooding on the other side is a major Geological / Geohazards which causes a series of damages on man and his properties. Flooding is mostly due to the natural causes. But however it can be controlled by certain catchment treatment or drainage treatment mechanism. In flooding geology, geomorphology, and slope and in other wards terrain systems substantially contribute to the flooding. At some places they accelerate runoff and certain places reduce the runoff depending upon their (terrain) architecture. Sometimes the nature of rivers and its migratory pattern causes flooding (for example Brahmaputra River). Human activity is another major dimension in flooding and related hazards. For example construction of dams in improper sites, lack of proper regulatory mechanism in water storage and release, deforestation, obstruction of drainage network etc., cause flooding. Improper land use / land cover also contributes to flooding. For example, in some of the coastal areas, deforestation of the mangroves has caused extensive flooding due to the stromsurge.

The areas affected by floods are generally large in size. Many different types of flooding exist, with different requirement as to the satellite imagery. River floods which can be seasonal floods, related to large rivers, or flash floods in the smaller catchment areas. Many factors play a role in the occurance of flooding, such as the intensity and duration of rain fall, snowmelt, deforestation, poor farming techniques, sedimentation in river bed and natural or manmade obstructions. In the evaluation of flood hazard, the flowing parameters should be taken in to account: depth of water during flood, duration, flow velocity, rate of rise and decline and the frequency of occurrence .The geospatial data by providing timely comprehensive and reliable information on flooded areas such as inundation phases, including duration, depth of inundation and direction of current, extent of damages to crops and property and prepare the flood hazard zonation mapping. This can be done with automated classification from IRS WIFS images. Furthermore PAN merged data can be used in the geomorphological mapping of the potential flood area and however the most crucial data is derived from the calculation peak discharges and return periods using from gauging stations. Radar images have been proven very useful for mapping peak flood inundation areas, crop damage assessment, especially due to their bad weather capability.

2.5 Cyclones

In india, cyclones hit east and west coast almost every year resulting in severe loss of life, infrastructure and property. In our country cyclones normally occur during April – May and October – December through they may occur during rainy season. The geospatial data can be utilized in three major aspects of cyclone hazard and its mitigation such as tracking, monitoring and forecasting, damage assessment and preventive measures. The most oblivious applications of satellite observations in the tropical region has been the tarcking and monitoring of tropical stroms, the economic benefit of providing early warning of cyclones has mone than amply justified the cost of entire meteorological programme. The tropical cyclone forecasting involves locating the position of cyclone. Assessing the present strength and predicting the future movement of cyclone in the form of speed and direction. INSAT system is being used routinely for foreasting cyclone activity and for emergency communication. However, damage assessment cabability of Indian satellite is rendered ineffective due to persistent cloud cover during the period of cyclone. SAR data from Radarsat has been effectively used to assess the crop damage assessment.

And also study the environmental changes due to the impact of Thana in 2014 and Gaja in 2018 cyclone.

3. CONCLUSION

The geospatial approach has advanced virtues in geoenvironment and natural disaster mapping and management such as earthquake, landslides, flooding, soil erosion and forest fire etc. In order to hazard inflicts severe damage to ecology and environment and related to economy of a region apart from loss of human lives. This technology has made a significant contribution in all preparedness, prevention and relief of hazard management.

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